

Claims

[c1] 1. A curable composition, comprising:

about 5 to about 50 parts by weight of a poly(arylene ether);

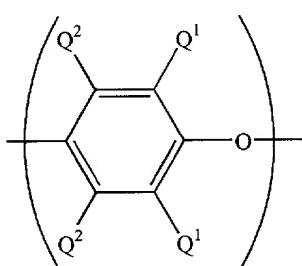
about 25 to 90 parts by weight of a thermosetting resin selected from the group consisting of epoxy resins, polyester resins, polyimide resins, bis-maleimide resins, cyanate ester resins, vinyl resins, benzoxazine resins, benzocyclobutene resins, and mixtures comprising at least one of the foregoing thermosetting resins;

about 0.5 to about 15 parts by weight of a compatibilizing agent selected from the group consisting of polyvinyl acetal resins, styrene-butadiene-styrene block copolymers, styrene-ethylene-styrene block copolymers, styrene-ethylene-butylene-styrene block copolymers, functionalized butadiene-acrylonitrile copolymers, styrene-butadiene core shell rubbers, styrene-butadiene-styrene core shell rubbers, and mixtures comprising at least one of the foregoing compatibilizing agents; and

about 3 to about 150 parts by weight per 100 parts of weight of the thermosetting resin of an amine cure agent selected from the group consisting of amidoamines, polyamides, cycloaliphatic amines, modified cycloaliphatic amines, aromatic amines, modified aromatic amines, BF_3 -amine adducts, imidazoles, guanidines, arylene polyamines, and mixtures comprising at least one of the foregoing amine cure agents;

wherein the parts by weight of the poly(arylene ether), the thermosetting resin, and the compatibilizing agent sum to 100.

[c2] 2. The composition of Claim 1, wherein the poly(arylene ether) comprises a plurality of structural units of the formula



wherein for each structural unit, each Q^1 is independently halogen, primary or secondary C_1-C_7 alkyl, phenyl, C_1-C_7 haloalkyl, C_1-C_7 aminoalkyl, C_1-C_7

C_7 hydrocarbonoxy, or C_2-C_7 halohydrocarbonoxy wherein at least two carbon atoms separate the halogen and oxygen atoms; and each Q^2 is independently hydrogen, halogen, primary or secondary C_1-C_7 alkyl, phenyl, C_1-C_7 haloalkyl, C_1-C_7 aminoalkyl, C_1-C_7 hydrocarbonoxy, or C_2-C_7 halohydrocarbonoxy wherein at least two carbon atoms separate the halogen and oxygen atoms.

- [c3] 3. The composition of Claim 2 wherein each Q^1 is independently C_1-C_7 alkyl, and each Q^2 is hydrogen.
- [c4] 4. The composition of Claim 3 wherein the poly(arylene ether) is a homopolymer comprising 2,6-dimethylphenylene ether units, or a random copolymer comprising 2,6-dimethylphenylene ether units in combination with 2,3,6-trimethyl-1,4-phenylene ether units.
- [c5] 5. The composition of Claim 1, wherein the poly(arylene ether) comprises a directly isolated poly(arylene ether).
- [c6] 6. The composition of Claim 1, wherein the poly(arylene ether) comprises a redistributed poly(arylene ether).
- [c7] 7. The composition of Claim 1, wherein the poly(arylene ether) has an intrinsic viscosity of about 0.20 dL/g to about 0.40 dL/g as measured at 25 °C in chloroform.
- [c8] 8. The composition of Claim 1, comprising about 10 to about 40 parts by weight of the poly(arylene ether) per 100 parts by weight total of the poly(arylene ether), the thermosetting resin, and the compatibilizing agent.
- [c9] 9. The composition of Claim 1, wherein the thermosetting resin comprises an epoxy resin.
- [c10] 10. The composition of Claim 1, wherein the thermosetting resin comprises a reaction product of 2,2-bis(4-hydroxyphenyl)propane and epichlorohydrin.
- [c11] 11. The composition of Claim 1, comprising about 50 to about 85 parts by weight of the thermosetting resin per 100 parts by weight total of the poly

(arylene ether), the thermosetting resin, and the compatibilizing agent.

- [c12] 12.The composition of Claim 1, wherein the compatibilizing agent comprises a polyvinyl acetal.
- [c13] 13.The composition of Claim 1, wherein the compatibilizing agent comprises a polyvinyl butyral.
- [c14] 14.The composition of Claim 1, comprising about 2 to about 10 parts by weight of the compatibilizing agent per 100 parts by weight total of the poly(arylene ether), the thermosetting resin, and the compatibilizing agent.
- [c15] 15.The composition of Claim 1, wherein the cure agent comprises an arylene polyamine.
- [c16] 16.The composition of Claim 1, wherein the cure agent comprises 4,4-methylenebis(2,6-diethylaniline).
- [c17] 17.The composition of Claim 1, comprising about 20 to about 100 parts by weight of the cure agent per 100 parts by weight of the thermosetting resin.
- [c18] 18.The composition of Claim 1, further comprising about 0.1 to about 20 parts by weight per 100 parts by weight poly(arylene ether) of a plasticizer effective for poly(arylene ether) resins.
- [c19] 19.The composition of Claim 18, wherein the plasticizer is selected from the group consisting of resorcinol diphosphate, bisphenol-A-diphosphate, isopropylated phenol phosphate, and mixtures comprising at least one of the foregoing plasticizers.
- [c20] 20.The composition of Claim 1, further comprising an additive selected from the group consisting of fillers, antioxidants, UV absorbers, thermal stabilizers, light stabilizers, pigments, dyes, colorants, anti-static agents, flame retardants, impact modifiers, mold release agents, and mixtures comprising at least one of the foregoing additives.
- [c21] 21.The curable resin composition of Claim 1, wherein the resin composition is substantially free of solvent.

[c22] 22.A curable composition, comprising:
about 10 to about 40 parts by weight of a poly(arylene ether) having an intrinsic viscosity of about 0.20 dL/g to about 0.40 dL/g as measured at 25 ° C in chloroform;
about 50 to about 85 parts by weight of an epoxy resin;
about 2 to about 10 parts by weight of a polyvinyl butyral; and
about 20 to about 100 parts by weight per 100 parts of weight of the thermosetting resin of an aromatic amine cure agent;
wherein the parts by weight of the poly(arylene ether), the thermosetting resin, and the compatibilizing agent sum to 100.

[c23] 23.A method of forming a curable resin composition, comprising:
forming an intimate blend comprising about 5 to about 50 parts by weight of a poly(arylene ether); about 25 to 90 parts by weight of a thermosetting resin selected from the group consisting of epoxy resins, polyester resins, polyimide resins, bis-maleimide resins, cyanate ester resins, vinyl resins, benzoxazine resins, benzocyclobutene resins, and mixtures comprising at least one of the foregoing thermosetting resins; about 0.5 to about 15 parts by weight of a compatibilizing agent selected from the group consisting of polyvinyl acetal resins, styrene-butadiene-styrene block copolymers, styrene-ethylene-styrene block copolymers, styrene-ethylene-butylene-styrene block copolymers, functionalized butadiene-acrylonitrile copolymers, styrene-butadiene core shell rubbers, styrene-butadiene-styrene core shell rubbers, and mixtures comprising at least one of the foregoing compatibilizing agents; and about 3 to about 150 parts by weight per 100 parts by weight thermosetting resin of an amine cure agent selected from the group consisting of amidoamines, polyamides, cycloaliphatic amines, modified cycloaliphatic amines, aromatic amines, modified aromatic amines, BF_3^- -amine adducts, imidazoles, guanidines, arylene polyamines, and mixtures comprising at least one of the foregoing amine cure agents; wherein the parts by weight of the poly(arylene ether), the thermosetting resin, and the compatibilizing agent sum to 100.

[c24] 24.The method of Claim 23, wherein at least about 50 weight percent of the total poly(arylene ether) is provided in the form of a solid concentrate

comprising about 30 weight percent to about 90 weight percent poly(arylene ether), and about 10 weight percent to about 70 weight percent thermosetting resin, wherein the weight percents are based on the total weight of the solid concentrate.

[c25] 25. The method of Claim 24, wherein forming an intimate blend comprises heating the poly(arylene ether), the thermosetting resin, and the compatibilizing agent to a temperature up to about 100 ° C.

[c26] 26. A method of forming a curable resin composition, comprising:
forming a first intimate blend comprising about 5 to about 50 parts by weight of a poly(arylene ether); about 25 to 90 parts by weight of a thermosetting resin selected from the group consisting of epoxy resins, polyester resins, polyimide resins, bis-maleimide resins, cyanate ester resins, vinyl resins, benzoxazine resins, benzocyclobutene resins, and mixtures comprising at least one of the foregoing thermosetting resins; and about 0.5 to about 15 parts by weight of a compatibilizing agent selected from the group consisting of polyvinyl acetal resins, styrene-butadiene-styrene block copolymers, styrene-ethylene-styrene block copolymers, styrene-ethylene-butylene-styrene block copolymers, functionalized butadiene-acrylonitrile copolymers, styrene-butadiene core shell rubbers, styrene-butadiene-styrene core shell rubbers, and mixtures comprising at least one of the foregoing compatibilizing agents; and
forming a second intimate blend comprising the first intimate blend and about 3 to about 150 parts by weight per 100 parts by weight thermosetting resin of an amine cure agent selected from the group consisting of amidoamines, polyamides, cycloaliphatic amines, modified cycloaliphatic amines, aromatic amines, modified aromatic amines, BF_3 -amine adducts, imidazoles, guanidines, arylene polyamines, and mixtures comprising at least one of the foregoing amine cure agents;
wherein the parts by weight of the poly(arylene ether), the thermosetting resin, and the compatibilizing agent sum to 100.

[c27] 27. The method of Claim 26, wherein forming the first intimate blend comprises heating the poly(arylene ether), the thermosetting resin, and the compatibilizing

agent to a temperature of at least about 150 ° C to form a homogeneous solution.

[c28] 28.The method of Claim 27, wherein forming the first intimate blend further comprises cooling the homogeneous solution to a temperature up to about 100 ° C to form a slurry of solid particles, wherein the solid particles have an average particle size up to about 1 millimeter.

[c29] 29.A method of forming a poly(arylene ether)-containing solid concentrate, comprising:
blending about 30 to about 90 parts by weight of a poly(arylene ether) and about 10 to about 70 parts by weight of a thermosetting resin in the presence of a suitable solvent to form a homogeneous solution; and
substantially removing the suitable solvent to yield a solid concentrate;
wherein the parts by weight of the poly(arylene ether) and the thermosetting resin sum to 100.

[c30] 30.The method of Claim 29, wherein the suitable solvent is selected from the group consisting of alcohols, ketones, aliphatic hydrocarbons, aromatic hydrocarbons, chlorohydrocarbons, nitrohydrocarbons, ethers, esters, amides, mixed ether-esters, sulfoxides, and mixtures comprising at least one of the foregoing solvents.

[c31] 31.The method of Claim 29, further comprising redistributing the poly(arylene ether) in the presence of a phenolic compound and an oxidizing agent to form a redistributed poly(arylene ether) having an intrinsic viscosity up to about 0.35 dL/g as measured at 25 ° C in chloroform.

[c32] 32.A method of forming a poly(arylene ether)-containing solid concentrate, comprising:
blending about 30 to about 90 parts by weight of a poly(arylene ether), about 10 to about 70 parts by weight of a thermosetting resin, and about 3 to about 150 parts by weight of a cure agent in the presence of a suitable solvent to form a homogeneous solution; and
removing the suitable solvent to yield a solid concentrate;

wherein the parts by weight of the poly(arylene ether) and the thermosetting resin sum to 100; and wherein the parts by weight of the cure agent are based on 100 parts by weight of the thermosetting resin.

- [c33] 33.A curable resin composition prepared according to the method of Claim 23.
- [c34] 34.A curable resin composition prepared according to the method of Claim 24.
- [c35] 35.A curable resin composition prepared according to the method of Claim 25.
- [c36] 36.A poly(arylene ether)-containing solid concentrate prepared according to the method of Claim 29.
- [c37] 37.A poly(arylene ether)-containing solid concentrate prepared according to the method of Claim 32.
- [c38] 38.A cured composition comprising the reaction product of:
 - about 5 to about 50 parts by weight of a poly(arylene ether);
 - about 25 to 90 parts by weight of a thermosetting resin selected from the group consisting of epoxy resins, polyester resins, polyimide resins, bis-maleimide resins, cyanate ester resins, vinyl resins, benzoxazine resins, benzocyclobutene resins, and mixtures comprising at least one of the foregoing thermosetting resins;
 - about 0.5 to about 15 parts by weight of a compatibilizing agent selected from the group consisting of polyvinyl acetal resins, styrene-butadiene-styrene block copolymers, styrene-ethylene-styrene block copolymers, styrene-ethylene-butylene-styrene block copolymers, functionalized butadiene-acrylonitrile copolymers, styrene-butadiene core shell rubbers, styrene-butadiene-styrene core shell rubbers, and mixtures comprising at least one of the foregoing compatibilizing agents; and
 - about 3 to about 150 parts by weight per 100 parts of weight of the thermosetting resin of an amine cure agent selected from the group consisting of amidoamines, polyamides, cycloaliphatic amines, modified cycloaliphatic amines, aromatic amines, modified aromatic amines, BF_3^- -amine adducts, imidazoles, guanidines, arylene polyamines, and mixtures comprising at least one of the foregoing amine cure agents;

wherein the parts by weight of the poly(arylene ether), the thermosetting resin, and the compatibilizing agent sum to 100.

[c39] 39. An article comprising the cured resin composition of Claim 38.